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A Review of What Has Changed Since the 2004 Beryllium Sampling and Analysis Study

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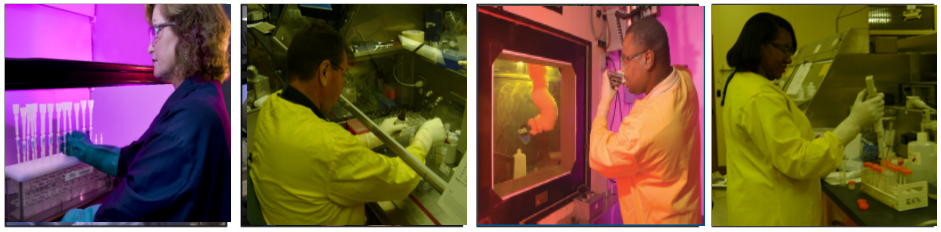

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Overview

- **The Way We Were in 2004**
  - Air and Surface Sampling, Sample Preparation, and Laboratory Analysis
  - Results from 2004 BHSC Sampling and Analysis Study
  - Open Questions and Opportunities
- **Developments and Learnings**
  - 2009 ACGIH® Threshold Limit Value® Change
  - Wall deposits
  - Be Oxide Dissolution Study
  - Increased use of ICP-MS and Fluorescence
  - New standard methods and guides (ASTM, ISO, etc.)
- **Goals for 2012 BHSC Study**
  - Are we any more consistent now than eight years ago?
  - What opportunities do we still have to improve?

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Not Addressed in This Presentation

- Potential changes to 10 CFR 850
- Potential changes to OSHA Permissible Exposure Limit
- Sampling or analysis methods still in a developmental mode (some of which have been discussed in other presentations)
- Focus is on the effects of what we have learned on *implementation* in the field and the lab

The Way We Were

- **2004 BHSC Study**
  - **Study team: Steve Jahn, Amy Ekechukwu, Kevin Ashley, Mike Brisson**
  - **Brisson et al., "Opportunities for Standardization of Beryllium Sampling and Analysis", *ASTM Special Technical Publication 1473*, August 2006**
  - **Brisson et al., "Trace-Level Beryllium Analysis in the Laboratory and in the Field: State of the Art, Challenges, and Opportunities", *J. Environ. Monit.*, 2006, 605-611, June 2006**
- **16 total respondents in 2004**
  - **DOE – 9**
  - **DoD – 3**
  - **One each from NIOSH, OSHA, Canada, UK**

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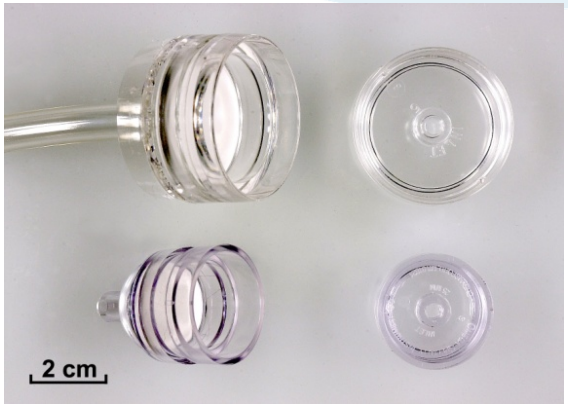
Air Sampling – The Way We Were

- 2004 Study asked few questions on this subject
- Only six participants responded
- Generally used MCE filters in closed face cassettes
- No expectation for particle size selective sampling



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Air Sampling – Developments and Learnings

- **2009 ACGIH® TLV®**
  - Reduced value to 0.05 μg/m^3 as an 8-hour time-weighted average
  - Invoked ISO 7708 inhalable sampling convention
  - Implementation not currently required by any U.S. regulations – BHSC discussions suggest very limited implementation in U.S.
- **Wall Deposits**
  - Issue for all particles collected on CFC's, not just Be
  - Can be addressed in several ways (presentations at 2012 Spring BHSC meeting and 2012 DOE IH meeting)
  - Action strongly recommended by NIOSH and is being incorporated into NMAM procedures
  - See Harper and Demange, *J. Occup. Env. Hygiene*, **4**, D81-D86 (2007) and NMAM home page: http://www.cdc.gov/niosh/docs/2003-154

ACGIH®

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Air Sampling – Where Do We Think We Are?

- **In the U.S., much the same as in 2004**
  - Status quo driven by cost issues and lack of a regulatory driver
  - Research has begun to develop a disposable inhalable sampler; this may have a future impact
- **Europe appears to be farther along in implementing particle-size selective sampling**
- **And the next wave is on the way: ISO 13138**
  - Based on deposition rather than penetration (ISO 7708)
  - Described in Sleeth/Brisson presentation

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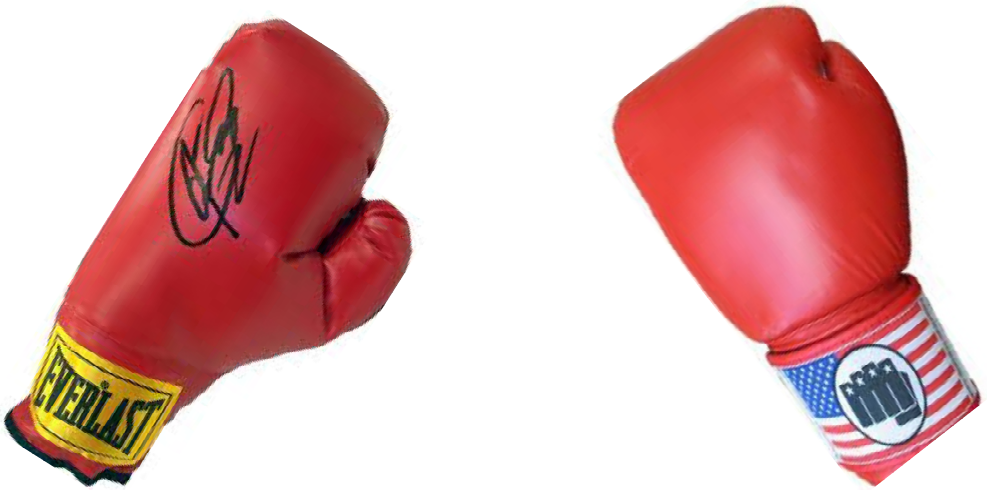
Surface Sampling – The Way We Were

For years the big argument was Wet versus Dry …



Six of 16 respondents in 2004 used dry wipes part or all of the time

Surface Sampling – More on The Way We Were

- **Wipe materials used by 2004 respondents:**
  - **GhostWipe®**
  - **Whatman® filter paper**
  - **Smear tabs**
  - **6 x 6 Gauze**
- **No questions or discussion on bulk sampling**
- **Although required mainly within DOE, wipe sampling was being done by nearly all 2004 respondents**

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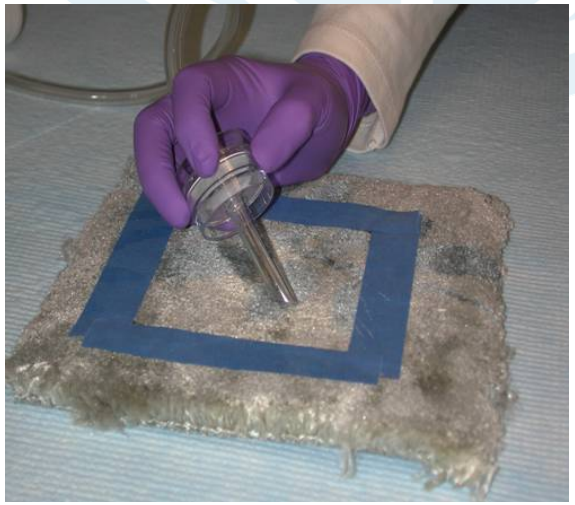
Surface Sampling – Where Do We Think We Are?

- **Field surface wiping**
  - Less use of dry wipes – but still necessary in some cases
  - New smaller wipes (ASTM D7707) discussed in Youmans-McDonald et al. presentation
- **Some interest/need for other forms of surface sampling**
  - Micro-vacuum (ASTM D7144)
  - Full size HEPA vacuum (ASTM D5438)
  - Bulk sampling (other than vacuum)
  - Dermal sampling?



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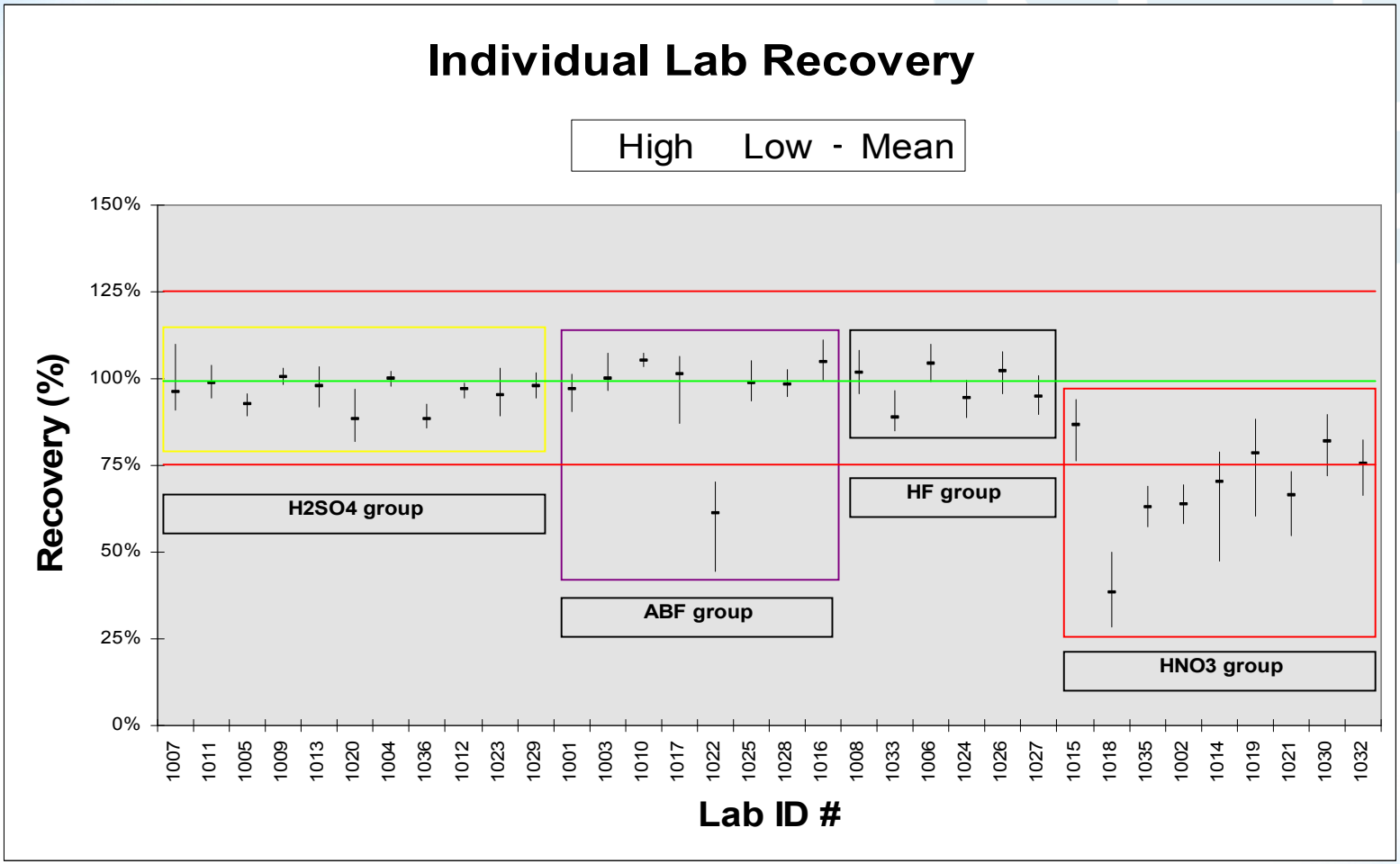
Sample Preparation – The Way We Were

- **Mostly NIOSH, EPA, OSHA methods, typically with some degree of modification**
- **Wide variety of digestion reagents used**
- **Some indications, but no firm data, suggesting that not all "standard" methods would fully dissolve beryllium oxide**
- **No BeO reference material to test sample preparation methods**

Sample Preparation – Developments and Learnings

- **DOE/NIOSH/NIST effort to establish a BeO reference material (SRM 1877) was key to resolving issues**
- **BHSC BeO dissolution study – Oatts et al., *J. Environ. Monit.*, 14, 391-401 (2012)**
  - **Demonstrated that fluoride (HF or NH_4HF_2) or H_2SO_4 required for full BeO dissolution – graphic depiction on next slide**
  - **NIOSH 7300 (unmodified) does not use HF or H_2SO_4**

Sample Preparation – BeO Study



From Oatts et al., *J. Environ. Monit.*, **14**, 391-401 (2012)

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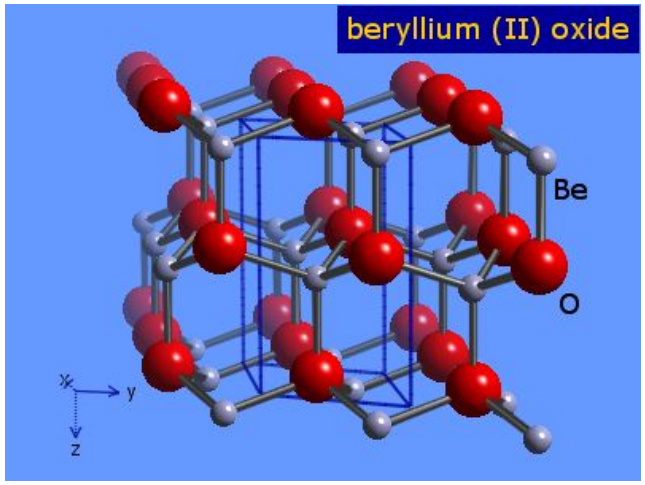
Sample Preparation – Where Do We Think We Are?

- **We think that sites concerned with BeO (potential or known) are migrating to methods that handle BeO**
- **Some sites are not concerned with BeO and may not have changed their sample preparation**



(www.webelements.com)

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Laboratory Analysis – The Way We Were

- **ICP-AES was predominant, especially in the U.S.**
- **ICP-MS was being used by a few sites**
- **Graphite furnace AA was also used at one site**
- **Fluorescence (NIOSH 7704/9110) was just becoming available**
- **NIOSH, EPA, OSHA methods (modified in many cases)**
- **Three respondents used in-house methods**

ICP-MS at
SRS Radiological Lab

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Lab Analysis – Developments and Where We Are

- Fluorescence has sensitivity comparable to ICP-MS
- Direct solid measurement techniques (such as LIBS) have not yet caught on, but still being pursued (Sutton et al. presentation)
- More are using ICP-MS and/or fluorescence for at least some samples
- Since these techniques can provide reporting limits below 10 nanograms per sample, improvement focus is now more on sample prep than lab analysis

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The 2012 Sampling and Analysis Study

- **Study team: Linda Youmans-McDonald, Steve Jahn, Kevin Ashley, Mike McCawley, Mike Brisson – as BHSC members, not in connection with their employers**
- **Study still in progress as of this presentation**
- **Seeking input from a wider audience than in 2004**
- **Areas of study include:**
  - **Background and Accreditation Information**
  - **Surface Characterization**
  - **Surface Sample Analysis**
  - **Air Sample Collection**
  - **Air Sample Analysis**

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Goals of the 2012 Study

- **Collect information from a wider audience**
- **Identify changes from 2004**
- **Determine if we are more or less consistent now than we were in 2004 – and how much that matters**
  - For instance, how much more are we using standard methods, and how much are we still modifying them
- **Determine opportunities for improvement, and where the BHSC (in particular, the Sampling and Analysis Subcommittee) should focus its efforts**
  - White papers, new or improved standard methods, etc.
- **Results will hopefully be presented and/or published at a later time**

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